

# ATL03 Product Data Dictionary

Date Generated : 2019-07-23T20:30:08.000000Z

Product Type: ATL03, Format Version : SET\_BY\_PGE

Group: /		
Conventions	(Attribute)	CF-1.6
citation	(Attribute)	SET_BY_META
contributor_name	(Attribute)	Thomas E Neumann (thomas.neumann@nasa.gov), Thorsten Markus (thorsten.markus@nasa.gov), Suneel Bhardwaj (suneel.bhardwaj@nasa.gov) David W Hancock III (david.w.hancock@nasa.gov)
contributor_role	(Attribute)	Instrument Engineer, Investigator, Principle Investigator, Data Producer, Data Producer
creator_name	(Attribute)	SET_BY_META
date_created	(Attribute)	SET_BY_PGE
date_type	(Attribute)	UTC
description	(Attribute)	This data set (ATL03) contains height above the WGS 84 ellipsoid (ITRF2014 reference frame), latitude, longitude, and time for all photons downlinked by the Advanced Topographic Laser Altimeter System (ATLAS) instrument on board the Ice, Cloud and land Ele
featureType	(Attribute)	trajectory
geospatial_lat_max	(Attribute)	0.0000000000000000
geospatial_lat_min	(Attribute)	0.0000000000000000
geospatial_lat_units	(Attribute)	degrees_north
geospatial_lon_max	(Attribute)	0.0000000000000000
geospatial_lon_min	(Attribute)	0.0000000000000000
geospatial_lon_units	(Attribute)	degrees_east
granule_type	(Attribute)	ATL03
hdfversion	(Attribute)	SET_BY_PGE
history	(Attribute)	SET_BY_PGE
identifier_file_uuid	(Attribute)	SET_BY_PGE
identifier_product_doi	(Attribute)	10.5067/ATLAS/ATL03.001
identifier_product_doi_authority	(Attribute)	<a href="http://dx.doi.org">http://dx.doi.org</a>
identifier_product_format_version	(Attribute)	SET_BY_PGE
identifier_product_type	(Attribute)	ATL03
institution	(Attribute)	SET_BY_META
instrument	(Attribute)	SET_BY_META
keywords	(Attribute)	SET_BY_META
keywords_vocabulary	(Attribute)	SET_BY_META
level	(Attribute)	L2
license	(Attribute)	Data may not be reproduced or distributed without including the citation for this product included in this metadata. Data may not be distributed in an altered form without the written permission of the ICESat-2 Science Project Office at NASA/GSFC.
naming_authority	(Attribute)	<a href="http://dx.doi.org">http://dx.doi.org</a>
platform	(Attribute)	SET_BY_META
processing_level	(Attribute)	L2A
project	(Attribute)	SET_BY_META
publisher_email	(Attribute)	SET_BY_META
publisher_name	(Attribute)	SET_BY_META
publisher_url	(Attribute)	SET_BY_META
references	(Attribute)	SET_BY_META
short_name	(Attribute)	ATL03
source	(Attribute)	SET_BY_META
spatial_coverage_type	(Attribute)	Horizontal
standard_name_vocabulary	(Attribute)	CF-1.6
summary	(Attribute)	SET_BY_META
time_coverage_duration	(Attribute)	SET_BY_PGE
time_coverage_end	(Attribute)	SET_BY_PGE

time_coverage_start	(Attribute)	SET_BY_PGE		
time_type	(Attribute)	CCSDS UTC-A		
title	(Attribute)	SET_BY_META		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
ds_surf_type (Compact Dataset)	INTEGER_4 (5)	Surface Type Dimension Scale (not_set)	1 not_set	Dimension scale indexing the surface type array. Index=1 corresponds to Land; index = 2 corresponds to Ocean; Index = 3 corresponds to Sealce; Index=4 corresponds to LandIce; Index=5 corresponds to InlandWater flag_values: 1, 2, 3, 4, 5 flag_meanings : land ocean seaice landice inland_water
ds_xyz (Compact Dataset)	INTEGER_4 (3)	XYZ Dimension Scale (not_set)	1 not_set	Dimension scale indexing the XYZ components of velocity_sc. Index=1 corresponds to X; index = 2 corresponds to Y; Index = 3 corresponds to Z; flag_values: 1, 2, 3 flag_meanings : x y z
<b>Group: /ancillary_data</b>				
Description	(Attribute)	Contains information ancillary to the data product. This may include product characteristics, instrument characteristics and/or processing constants.		
data_rate	(Attribute)	Data within this group pertain to the granule in its entirety.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
atl03_pad (Compact Dataset)	DOUBLE (1)	Padding for ATL03 processing (not_set)	seconds Control	Seconds of padding data needed for ATL03 processing.
atlas_sdp_gps_epoch (Compact Dataset)	DOUBLE (1)	ATLAS Epoch Offset (not_set)	seconds since 1980-01-06T00:00:00.000000Z Operations	Number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS Standard Data Product (SDP) epoch (2018-01-01:T00.00.00.000000 UTC). Add this value to delta time parameters to compute full gps_seconds (relative to the GPS epoch) for each data point.
control (Contiguous Dataset)	STRING:100000 (1)	Control File (not_set)	1 Operations	PGE-specific control file used to generate this granule. To re-use, replace breaks (BR) with linefeeds.
data_end_utc (Compact Dataset)	STRING:27 (1)	End UTC Time of Granule (CCSDS-A, Actual) (not_set)	1 Derived	UTC (in CCSDS-A format) of the last data point within the granule.
data_start_utc (Compact Dataset)	STRING:27 (1)	Start UTC Time of Granule (CCSDS-A, Actual) (not_set)	1 Derived	UTC (in CCSDS-A format) of the first data point within the granule.
end_cycle (Compact Dataset)	INTEGER_4 (1)	Ending Cycle (not_set)	1 Derived	The ending cycle number associated with the data contained within this granule. The cycle number is the counter of the number of 91-day repeat cycles completed by the mission.
end_delta_time (Compact Dataset)	DOUBLE (1)	ATLAS End Time (Actual) (time)	seconds since 2018-01-01 Derived	Number of GPS seconds since the ATLAS SDP epoch at the last data point in the file. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
end_geoseg (Compact Dataset)	INTEGER_4 (1)	Ending Geolocation Segment (not_set)	1 Derived	The ending geolocation segment number associated with the data contained within this granule. ICESat granule geographic regions are further refined by geolocation segments. During the geolocation process, a geolocation segment is created approximately every 20m from the start of the orbit to the end. The geolocation segments help align the ATLAS strong a weak beams and provide a common segment length for the L2 and higher products. The geolocation segment indices differ slightly from orbit-to-orbit because of the irregular shape of the Earth. The geolocation segment indices on ATL01 and ATL02 are only approximate because beams have not been aligned at the time of their creation.
end_gpssow (Compact Dataset)	DOUBLE (1)	Ending GPS SOW of Granule (Actual) (not_set)	seconds Derived	GPS seconds-of-week of the last data point in the granule.
end_gpsweek (Compact Dataset)	INTEGER_4 (1)	Ending GPSWeek of Granule (Actual) (not_set)	weeks from 1980-01-06 Derived	GPS week number of the last data point in the granule.
end_orbit (Compact Dataset)	INTEGER_4 (1)	Ending Orbit Number (not_set)	1 Derived	The ending orbit number associated with the data contained within this granule. The orbit number increments each time the spacecraft completes a full orbit of the Earth.
end_region (Compact Dataset)	INTEGER_4 (1)	Ending Region (not_set)	1 Derived	The ending product-specific region number associated with the data contained within this granule. ICESat-2 data

				products are separated by geographic regions. The data contained within a specific region are the same for ATL01 and ATL02. ATL03 regions differ slightly because of different geolocation segment locations caused by the irregular shape of the Earth. The region indices for other products are completely independent.
end_rgt (Compact Dataset)	INTEGER_4 (1)	Ending Reference Groundtrack (not_set)	1 Derived	The ending reference groundtrack (RGT) number associated with the data contained within this granule. There are 1387 reference groundtrack in the ICESat-2 repeat orbit. The reference groundtrack increments each time the spacecraft completes a full orbit of the Earth and resets to 1 each time the spacecraft completes a full cycle.
granule_end_utc (Compact Dataset)	STRING:27 (1)	End UTC Time of Granule (CCSDS-A, Requested) (not_set)	1 Derived	Requested end time (in UTC CCSDS-A) of this granule.
granule_start_utc (Compact Dataset)	STRING:27 (1)	Start UTC Time of Granule (CCSDS-A, Requested) (not_set)	1 Derived	Requested start time (in UTC CCSDS-A) of this granule.
podppd_pad (Compact Dataset)	DOUBLE (1)	Padding for POD/PPD Interpolation (not_set)	seconds Control	Seconds of padding data needed for POD/PPD interpolation.
release (Compact Dataset)	STRING:80 (1)	Release Number (not_set)	1 Operations	Release number of the granule. The release number is incremented when the software or ancillary data used to create the granule has been changed.
start_cycle (Compact Dataset)	INTEGER_4 (1)	Starting Cycle (not_set)	1 Derived	The starting cycle number associated with the data contained within this granule. The cycle number is the counter of the number of 91-day repeat cycles completed by the mission.
start_delta_time (Compact Dataset)	DOUBLE (1)	ATLAS Start Time (Actual) (time)	seconds since 2018-01-01 Derived	Number of GPS seconds since the ATLAS SDP epoch at the first data point in the file. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
start_geoseg (Compact Dataset)	INTEGER_4 (1)	Starting Geolocation Segment (not_set)	1 Derived	The starting geolocation segment number associated with the data contained within this granule. ICESat granule geographic regions are further refined by geolocation segments. During the geolocation process, a geolocation segment is created approximately every 20m from the start of the orbit to the end. The geolocation segments help align the ATLAS strong a weak beams and provide a common segment length for the L2 and higher products. The geolocation segment indices differ slightly from orbit-to-orbit because of the irregular shape of the Earth. The geolocation segment indices on ATL01 and ATL02 are only approximate because beams have not been aligned at the time of their creation.
start_gpssow (Compact Dataset)	DOUBLE (1)	Start GPS SOW of Granule (Actual) (not_set)	seconds Derived	GPS seconds-of-week of the first data point in the granule.
start_gpsweek (Compact Dataset)	INTEGER_4 (1)	Start GPSWeek of Granule (Actual) (not_set)	weeks from 1980-01-06 Derived	GPS week number of the first data point in the granule.
start_orbit (Compact Dataset)	INTEGER_4 (1)	Starting Orbit Number (not_set)	1 Derived	The starting orbit number associated with the data contained within this granule. The orbit number increments each time the spacecraft completes a full orbit of the Earth.
start_region (Compact Dataset)	INTEGER_4 (1)	Starting Region (not_set)	1 Derived	The starting product-specific region number associated with the data contained within this granule. ICESat-2 data products are separated by geographic regions. The data contained within a specific region are the same for ATL01 and ATL02. ATL03 regions differ slightly because of different geolocation segment locations caused by the irregular shape of the Earth. The region indices for other products are completely independent.
start_rgt (Compact Dataset)	INTEGER_4 (1)	Starting Reference Groundtrack (not_set)	1 Derived	The starting reference groundtrack (RGT) number associated with the data contained within this granule. There are 1387 reference groundtrack in the ICESat-2 repeat orbit. The reference groundtrack increments each time the spacecraft completes a full orbit of the Earth and resets to 1 each time the spacecraft completes a full cycle.
version (Compact Dataset)	STRING:80 (1)	Version (not_set)	1 Operations	Version number of this granule within the release. It is a sequential number corresponding to the number of times the granule has been reprocessed for the current release.
<b>Group: /ancillary_data/atlas_engineering</b>				
Description	(Attribute)	This group contains statistics for ATLAS engineering data.		

Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
det_ab_flag (Compact Dataset)	INTEGER_4 (1)	Detector Side, A or B (not_set)	1 Derived, L1B ATBD	Indicates if the active detector (DET) is side A (1) or side B (2). flag_values: 1, 2 flag_meanings: a b
ds_gt (Contiguous Dataset)	INTEGER_1 (6)	GT Index (not_set)	1 not_set	Dimension scale for ATLAS Groundtracks (gt1l, gt1r, gt2l, gt2r, gt3l, gt3r) flag_values: 1, 2, 3, 4, 5, 6 flag_meanings: gt1l gt1r gt2l gt2r gt3l gt3r
ds_stat (Contiguous Dataset)	INTEGER_1 (4)	Stat Index (not_set)	1 not_set	Dimension scale for statistics in the order mean, sdev, min, max flag_values: 1, 2, 3, 4 flag_meanings: mean sdev min max
hvpc_ab_flag (Compact Dataset)	INTEGER_4 (1)	HVPC Side, A or B (not_set)	1 Derived, L1B ATBD	Indicates if the active High Voltage Power Converter (HVPC) is side A (1) or side B (2). flag_values: 1, 2 flag_meanings: a b
laser_12_flag (Compact Dataset)	INTEGER_4 (1)	Laser 1 or Laser 2 (not_set)	1 Derived, L1B ATBD	Indicates if the active Laser is laser 1 or laser 2. flag_values: 1, 2 flag_meanings: 1 2
lrs_ab_flag (Compact Dataset)	INTEGER_4 (1)	LRS Side A or B (not_set)	1 Derived, L1B ATBD	Indicates if the active LRS is side A (1) or side B (2). flag_values: 1, 2 flag_meanings: a b
pdu_ab_flag (Compact Dataset)	INTEGER_4 (1)	PDU Side A or B (not_set)	1 Derived, L1B ATBD	Indicates if the active PDU is side a (1) or side b (2). flag_values: 1, 2 flag_meanings: a b
ph_uncorrelated_error (Compact Dataset)	FLOAT (1,6)	Uncorrelated Error (not_set)	meters ATL03 ATBD, Section 7.7.2	The estimate of uncorrelated height error. This is a six-valued array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter.
spd_ab_flag (Compact Dataset)	INTEGER_4 (1)	SPD A or B (not_set)	1 Derived, L1B ATBD	Indicates if the active Start Pulse Detector (SPD) is side a (1) or side b (2). flag_values: 1, 2 flag_meanings: a b
tams_ab_flag (Compact Dataset)	INTEGER_4 (1)	TAMS Side A or B (not_set)	1 Derived, L1B ATBD	Indicates if the active TAMS is side a (1) or side b (2). flag_values: 1, 2 flag_meanings: a b

**Group: /ancillary\_data/atlas\_engineering/receiver**

Description	(Attribute)	This group contains receiver parameters.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
rx_bckgrd_sensitivity (Compact Dataset)	FLOAT (4,6)	Receiver background sensitivity (not_set)	events/joule ATL02 ATBD, Sections 5.3.2	Per-beam receiver background sensitivity. This is a six-valued array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter.
rx_return_sensitivity (Compact Dataset)	FLOAT (4,6)	Receiver return sensitivity (not_set)	events/joule ATL02 ATBD, Sections 5.3.2	Per-beam receiver return sensitivity. This is a six-valued array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter.

**Group: /ancillary\_data/atlas\_engineering/transmit**

Description	(Attribute)	This group contains transmit parameters.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
tx_pulse_distribution (Compact Dataset)	FLOAT (1,6)	transmit pulse energy distribution (not_set)	1 ATL03 ATBD, Section 7.2	The fraction of the transmit pulse energy in a given beam, based on pre-launch calibration. This is a six-valued array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter.
tx_pulse_energy (Compact Dataset)	FLOAT (4,6)	ATLAS Transmit Energy (not_set)	joules ATL03 ATBD Section 7.2.1	The mean, standard deviation, minimum and maximum values of the transmit energy for each beam as reported by the start pulse detector, averaged over a given ATL03 granule. This is a 6x4 array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter.
tx_pulse_skew_est (Compact Dataset)	FLOAT (4,1)	transmit pulse shape skew (not_set)	seconds ATL02, described in ATL03 ATBD Section 7.2.1	The difference between the means of the lower and upper threshold crossing times; a positive value corresponds to a positive skew in the pulse, and conversely for a negative value.
tx_pulse_thresh_lower (Compact Dataset)	FLOAT (4,1)	transmit pulse lower threshold (not_set)	volts ATL03 ATBD, Section 7.2	The lower threshold setting of the start pulse detector. The threshold crossing times are used to determine the start pulse time, and estimate the start pulse shape. If this setting changes during a given granule, this parameter becomes two-valued.

tx_pulse_thresh_upper (Compact Dataset)	FLOAT (4,1)	transmit pulse upper threshold (not_set)	volts ATL03 ATBD, Section 7.2	The upper threshold setting of the start pulse detector. The threshold crossing times are used to determine the start pulse time, and estimate the start pulse shape. If this setting changes during a given granule, this parameter becomes two-valued.
tx_pulse_width_lower (Compact Dataset)	FLOAT (4,1)	lower threshold crossing time difference (not_set)	seconds ATL02, described in ATL03 ATBD Section 7.2.1	The difference between the two crossing times of the transmit pulse
tx_pulse_width_upper (Compact Dataset)	FLOAT (4,1)	upper threshold crossing time difference (not_set)	seconds ATL02, described in ATL03 ATBD Section 7.2.1	The difference between the two crossing times of the transmit pulse

**Group: /ancillary\_data/calibrations**

Description	(Attribute)	This group contains calibrations derived from the ATLAS CAL products.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
ds_channel (Contiguous Dataset)	INTEGER_1 (20)	Channel (not_set)	1 not_set	Dimension scale for ATLAS PCE channels (1-16=strong, 17-20=weak)

**Group: /ancillary\_data/calibrations/dead\_time**

Description	(Attribute)	CAL42 - Dead-time. Estimates dead time for each ATLAS receiver channel accompanied by an estimated standard deviation for that measurement. photoelectrons/spot/shot, channel-to-channel basis.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
cal42_product (Compact Dataset)	STRING:80 (1)	CAL Product Name (not_set)	1 CAL42	Name of ATLAS CAL Product containing the calibration data
side (Compact Dataset)	INTEGER_4 (1)	Detector Bank Side (not_set)	1 CAL42	A or B side of the detector bank flag_values: 1, 2 flag_meanings : A B
temperature (Compact Dataset)	FLOAT (1)	Temperature (not_set)	degreesC CAL42	Temperature for which calibrations are provided.

**Group: /ancillary\_data/calibrations/dead\_time/gtx**

Description	(Attribute)	CAL42 - Dead-time. Estimates dead time for each ATLAS receiver channel accompanied by an estimated standard deviation for that measurement. photoelectrons/spot/shot, channel-to-channel basis.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
dead_time (Compact Dataset)	DOUBLE (20)	DeadTime (not_set)	seconds CAL42	Dead Time (channel)
sigma (Compact Dataset)	DOUBLE (20)	Sigma (not_set)	seconds CAL42	Sigma (channel)

**Group: /ancillary\_data/calibrations/dead\_time\_radiometric\_signal\_loss**

Description	(Attribute)	CAL34 - Dead-time Radiometric Signal Loss. Contains a table of radiometric corrections versus apparent return strength and width for several dead-time values. Correction is to be multiplied by raw return strength to get corrected return strength		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
cal34_product (Chunked Dataset)	STRING:80 (:)	CAL Product Name (not_set)	1 CAL34	Name of ATLAS CAL Products containing the calibration data

**Group: /ancillary\_data/calibrations/dead\_time\_radiometric\_signal\_loss/gtx**

Description	(Attribute)	CAL34 - Dead-time Radiometric Signal Loss. Provides a measure of counting efficiency loss as function of first photon bias for received photoelectron populations via combinations of return signal pulsewidth & mean photoelectrons/spot/shot, channel-to-channel basis.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
dead_time (Chunked Dataset)	FLOAT (:)	Dead Time (not_set)	ns CAL34	Dead time value
rad_corr (Chunked Dataset)	DOUBLE (:, :, :)	Radiometric Correction (not_set)	1 CAL34	Radiometric Correction (width, strength, deadtime)
strength (Chunked Dataset)	DOUBLE (:, :)	Beam Strength (not_set)	1 CAL34	Spot strength in events/shot (strength, deadtime)
width (Chunked Dataset)	DOUBLE (:, :)	Apparent Width (not_set)	ns CAL34	Apparent width (width, deadtime)

**Group: /ancillary\_data/calibrations/first\_photon\_bias**

Description	(Attribute)	CAL19 -First Photon Bias. Provides a correction for first photon bias.		
Label	Datatype	long_name	units	description

(Layout)	(Dimensions)	(standard_name)	source	
cal19_product (Chunked Dataset)	STRING:80 (:)	CAL Product Name (not_set)	1 CAL19	Name of ATLAS CAL Products containing the calibration data
<b>Group: /ancillary_data/calibrations/first_photon_bias/gtx</b>				
Description	(Attribute)	CAL19 -First Photon Bias. Provides a correction for first photon bias.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
dead_time (Chunked Dataset)	FLOAT (:)	Dead Time (not_set)	ns CAL19	Dead time value
ffb_corr (Chunked Dataset)	DOUBLE (:, :, :)	FFB Correction (not_set)	ps CAL19	First Photon Bias Correction (width, strength, deadtime) in picoseconds.
strength (Chunked Dataset)	DOUBLE (:, :)	Beam Strength (not_set)	1 CAL19	Spot strength in events/shot (strength, deadtime)
width (Chunked Dataset)	DOUBLE (:, :)	Apparent Width (not_set)	ns CAL19	Apparent width (width, deadtime)
<b>Group: /ancillary_data/calibrations/low_link_impulse_response</b>				
Description	(Attribute)	CAL20 - System low link impulse response. Calibrates receiver impulse response, including optical and electrically introduced reflections.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
bin_width (Compact Dataset)	FLOAT (1)	Bin Width (not_set)	seconds CAL20	Histogram bin width
cal20_product (Compact Dataset)	STRING:80 (1)	CAL Product Name (not_set)	1 CAL20	Name of ATLAS CAL Product containing the calibration data
hist_x (Contiguous Dataset)	DOUBLE (2000)	Histogram Bin X Values (not_set)	1 CAL20	Histogram bin x-values
laser (Compact Dataset)	INTEGER_4 (1)	Laser (not_set)	1 CAL20	Laser Number
mode (Compact Dataset)	INTEGER_4 (1)	Laser Power Setting (not_set)	1 CAL20	Laser Power Setting
num_bins (Compact Dataset)	INTEGER_4 (1)	Number of Bins (not_set)	1 CAL20	Number of bins in the histogram
return_source (Compact Dataset)	INTEGER_4 (1)	Return Source (not_set)	1 CAL20	Source of the events from which the data are derived. flag_values: 0, 1, 2, 3 flag_meanings : none tep maat echo
side (Compact Dataset)	INTEGER_4 (1)	A_or_B (not_set)	1 CAL20	A or B Side Component flag_values: 1, 2 flag_meanings : A B
temperature (Compact Dataset)	FLOAT (1)	Temperature (not_set)	degreesC CAL20	Temperature for which calibrations are provided.
<b>Group: /ancillary_data/calibrations/low_link_impulse_response/gtx</b>				
Description	(Attribute)	CAL20 - System low link impulse response. Calibrates receiver impulse response, including optical and electrically introduced reflections.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
hist (Contiguous Dataset)	DOUBLE (2000,20)	Histogram (not_set)	1 CAL20	Per-Channel Histogram
total_events (Compact Dataset)	INTEGER_8 (20)	Total Events (not_set)	1 CAL20	Number of events used in constructing the per-channel histogram
<b>Group: /ancillary_data/gtx</b>				
Description	(Attribute)	Contains ancillary data used by the signal finding routine described in the ICESat-2 Global Geolocated Photons ATBD.		
<b>Group: /ancillary_data/gtx/signal_find_input</b>				
Description	(Attribute)	Group contains the setup parameters for the signal finding algorithm.		
data_rate	(Attribute)	Parameters in this group are single-instances valid for the entire file.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
addpad_flag (Compact Dataset)	INTEGER_4 (5)	Additional photon flag (not_set)	1 ATL03, Section 5, Addpad	Binary (logical) that if true (=1) then identify additional photon events as padding to achieve htspanin for each time interval sig_find_t_inc.
alpha_inc (Compact Dataset)	DOUBLE (5)	Slope Increment (not_set)	radians ATL03, Section 5, _inc	Increment by which the slope is varied for slant histogramming over large gaps
alpha_max	DOUBLE	Maximum Slope	radians	Maximum slope allowed for slant histogram; if larger than this

(Compact Dataset)	(5)	(not_set)	ATL03, Section 5, _max	then don
delta_t_gap_min (Compact Dataset)	DOUBLE (5)	Mimimum delta time gap (not_set)	seconds ATL03, Section 5, _time_gapmin	Minimum size of a time gap in the height profile over which to use variable slope slant histogramming.
delta_t_lin_fit (Compact Dataset)	DOUBLE (5)	Linear fit time increment (not_set)	seconds ATL03, Section 5, _t_linfit_edit	Time span over which to perform a running linear fit to identified signal photon events when editing outliers. Surface type dependent.
delta_t_max (Compact Dataset)	DOUBLE (5)	Histogram Maximum time (not_set)	seconds ATL03, Section 5, _tmax	Maximum time interval over which photons are selected to histogram. Surface-type dependent.
delta_t_min (Compact Dataset)	DOUBLE (5)	Histogram Minimum time (not_set)	seconds ATL03, Section 5, _tmin	Minimum time interval over which photons are selected to histogram. Surface-type dependent.
delta_z_bg (Compact Dataset)	DOUBLE (5)	Histogram height bin size for noise calculation from photon cloud (not_set)	seconds ATL03, Section 5, _zBG	Width of a height bin in each atmospheric histogram, Ha, if calculating Ha from the photon cloud. Surface-type dependent.
delta_zmax2 (Compact Dataset)	DOUBLE (5)	Maximum height bin size 2 (not_set)	meters ATL03, Section 5, _zmax2	Maximum height bin size for histogramming for second sweep. Surface-type dependent.
delta_zmin (Compact Dataset)	DOUBLE (5)	Minimum height bin size (not_set)	meters ATL03, Section 5, _zmin	Minimum height bin size for histogramming for first sweep. Surface-type dependent.
e_a (Compact Dataset)	DOUBLE (5)	Multiplier of Ha_sigma (not_set)	1 ATL03, Section 5, ea	Multiplier of Ha_sigma used to determine which bins in the atmospheric histogram may contain signal photon events. Surface-type dependent.
e_linfit_edit (Compact Dataset)	DOUBLE (5)	Multiplier of STD of linear fit (not_set)	1 ATL03, Section 5, e_linfit_edit	Multiplier of standard deviation of linear fit to signal photons used to edit out noise during running linear fit edit of outliers.
e_linfit_slant (Compact Dataset)	DOUBLE (5)	Multiplier of sigma linfit (not_set)	1 ATL03, Section 5, e_linfit_slant	Multiplier of sigma_linfit, the standard deviation of the residuals between the actual photon events used to estimate the surface using a linear fit; all photons with height > e_linfit_slant
e_m (Compact Dataset)	DOUBLE (5)	Multiplier of STD of background (not_set)	1 ATL03, Section 5, em	Multiplier of standard deviation of the number of background photon events per bin used in determining signal photon threshold. Surface-type dependent.
e_m_mult (Compact Dataset)	DOUBLE (5)	Multiplier of STD of e_m (not_set)	1 ATL03, Section 5, em_mult	Multiplier of e_m used to determine Thsig2, threshold for singular bins. Surface-type dependent.
htspanmin (Compact Dataset)	DOUBLE (5)	Minimum height span (not_set)	meters ATL03, Section 5, Htspanmin	Minimum height span for each time interval of photons with confidence flag > 0. If the height span is < htspanmin then all photons not previously selected within +/- htspanmin/2 of the median height of the signal photons selected are marked with a confidence flag of 1. Surface-type dependent.
Islant_flag (Compact Dataset)	INTEGER_4 (5)	Flag to request slant histogramming for strong beams. (not_set)	1 ATL03, Section 5, Islant	Binary (logical) flag, if true (=1) then perform slant histogramming for the strong beam. Surface-type dependent. flag_values: 0, 1 flag_meanings : false true
min_fit_time_fact (Compact Dataset)	INTEGER_4 (5)	minimum fit time factor (not_set)	seconds ATL03, Section 5, min_fit_time_fact	The factor to multiply DTIME by to obtain the minimum time over which to fit a line to a height profile to calculate the local slope using running linear fits, min_fit_time.
n_delta_z1 (Compact Dataset)	INTEGER_4 (5)	number of increments in z1 (not_set)	counts ATL03, Section 5, n_z1	The number of increments between delta_zmin and delat_zmax1. Surface-type dependent.
n_delta_z2 (Compact Dataset)	INTEGER_4 (5)	number of increments in z2 (not_set)	counts ATL03, Section 5, n_z2	The number of increments between delta_zmax1 and delta_zmax2. Surface-type dependent.
nbin_min (Compact Dataset)	INTEGER_4 (5)	Minimum number of bins (not_set)	counts ATL03, Section 5, Nbinmin	Minimum number of bins in a histogram required for the algorithm to be able to process the histogram.
nphot_min (Compact Dataset)	INTEGER_4 (5)	Minimum number of photons to fill gap (not_set)	counts ATL03, Section 5, Nphotmin	The minimum number of photons over which to perform a linear fit to estimate the surface profile across a gap. Surface-type dependent.
nslw (Compact Dataset)	DOUBLE (5)	half height for slant histogramming (not_set)	meters ATL03, Section 5, nslw	Half of the value of the height window used for slant histogramming relative to the surface defined by the linear fit to the surrounding photons at slope, alpha. Surface-type dependent.
nslw_v (Compact Dataset)	DOUBLE (5)	Half height for variable slope slant histogramming (not_set)	meters ATL03, Section 5, nslw_v	Half the value of the height window used for slant histogramming relative to the surface used when varying the surface slope, alpha, to fill large gaps. Surface-type dependent.
out_edit_flag (Compact Dataset)	INTEGER_4 (5)	outlier edit flag (not_set)	1 ATL03, Section 5, Ledit	Binary (logical) flag, if true (=1) then perform an n_edit on a running linear fit to identified signal to remove outliers. Surface-type dependent. flag_values: 0, 1

				flag_meanings : false true
pc_bckgrd_flag (Compact Dataset)	INTEGER_4 (5)	calculated background rate flag (not_set)	1 ATL03, Section 5, Lpcbg	Binary (logical) flag, if true (=1) then always use the photon cloud to calculate the background photon rate, if false only use the photon cloud in the absence of the atmospheric histogram. Surface-type dependent. flag_values: 0, 1 flag_meanings : false true
r (Compact Dataset)	DOUBLE (5)	Minimum ratio (not_set)	1 ATL03, Section 5, R	Minimum ratio of max number of photons in histogram bin to mean noise value that must exist to consider a bin a signal bin.
r2 (Compact Dataset)	DOUBLE (5)	Minimum ratio2 (not_set)	1 ATL03, Section 5, R2	Minimum ratio of (maximum number of photons in any one bin of contiguous signal bins)/(Maximum number of photons in largest bin) in order to accept a group of potential signal bins as signal. Surface-type dependent.
sig_find_t_inc (Compact Dataset)	DOUBLE (5)	Histogram time increment (not_set)	seconds ATL03, Section 5, _time	Time increment the algorithm uses to step through the photon cloud in a granule. Histograms are formed at each sig_find_t_inc interval to identify signal photon events.
snrlow (Compact Dataset)	DOUBLE (5)	Signal to noise ratio low (not_set)	1 ATL03, Section 5, snrlow	Signal to noise ratio below which all selected signal has low confidence.
snrmed (Compact Dataset)	DOUBLE (5)	Signal to noise ratio medium (not_set)	1 ATL03, Section 5, snrmed	Signal to noise ratio above which all selected signal has high confidence. Selected signal with signal to noise ratio between snrlow and snrmed is marked as medium confidence.
t_gap_big (Compact Dataset)	DOUBLE (5)	Gap size criteria (not_set)	seconds ATL03, Section 5, tgapbig	For time gaps less than this value, slant histogramming is performed relative to the linear slope calculated from the surrounding signal. For time gaps greater than or equal to this value the slope is varied when performing slant histogramming. Surface-type dependent.

**Group: /ancillary\_data/tep**

Description	(Attribute)	Contains information ancillary to the data product. This may include product characteristics, instrument characteristics and/or processing constants.		
data_rate	(Attribute)	Data within this group pertain to the granule in its entirety.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
ds_gt (Contiguous Dataset)	INTEGER_1 (6)	GT Index (not_set)	1 not_set	Dimension scale for ATLAS Groundtracks (gt1l, gt1r, gt2l, gt2r, gt3l, gt3r) flag_values: 1, 2, 3, 4, 5, 6 flag_meanings : gt1l gt1r gt2l gt2r gt3l gt3r
min_tep_ph (Compact Dataset)	INTEGER_4 (1)	Minimum TEP photons (not_set)	seconds Derived	Minimum number of TEP photons required for computing a TEP histogram.
min_tep_secs (Compact Dataset)	DOUBLE (1)	Minimum TEP Seconds (not_set)	seconds Derived	Minimum seconds of data required for computing a TEP histogram.
n_tep_bins (Compact Dataset)	INTEGER_4 (1)	Number of Bins (not_set)	counts Derived	Number of bins in each TEP histogram
tep_bin_size (Compact Dataset)	FLOAT (1)	TEP Bin Size (not_set)	seconds Derived	Size of each TEP histogram bin.
tep_gap_size (Compact Dataset)	DOUBLE (1)	TEP Gap Size (not_set)	seconds Derived	Minimum number of seconds separating each TEP histogram instance.
tep_normalize (Compact Dataset)	INTEGER_4 (1)	Normalization Enabled (not_set)	1 Ops	Indicates if the TEP histogram was normalized. 0=not normalized; 1=normalized flag_values: 0, 1 flag_meanings : not_normalized normalized
tep_peak_bins (Compact Dataset)	INTEGER_4 (1)	Number of Peak Bins to Remove (not_set)	counts Derived	Number of peak bins to remove for TEP background computation.
tep_prim_window (Compact Dataset)	FLOAT (2)	TEP Primary Window (not_set)	seconds Derived	The range of the primary TEP window. Bins within this range are used in computing TEP rate.
tep_range_prim (Compact Dataset)	FLOAT (2)	Range of Primary TEP Window (not_set)	seconds ATL03 ATBD	The range of time of flight of TEP photon events to include in generating a histogram or other analysis of the primary TEP return
tep_rm_noise (Compact Dataset)	INTEGER_4 (1)	Noise Removal Enabled (not_set)	1 Ops	Indicates if noise was removed from the TEP histogram. 0=background noise not removed; 1=background noise removed flag_values: 0, 1 flag_meanings : noise_not_removed noise_removed
tep_sec_window (Compact Dataset)	FLOAT (2)	TEP Secondary Window (not_set)	seconds Derived	The range of the secondary TEP window. Bins within this range are used in computing TEP rate.
tep_start_x (Compact Dataset)	FLOAT (1)	TEP Start X (not_set)	seconds Derived	Value at the left edge of the first histogram bin.

tep_valid_spot (Compact Dataset)	INTEGER_1 (6)	Index of TEP Spot (not_set)	1 ATL03 ATBD	A 6x1 array indicating which TEP to use for each spot that does not have a TEP associated with it (e.g. which TEP to use to characterize spots 2, 4, 5, and 6). flag_values: 1, 2 flag_meanings : pce1_spot1 pce2_spot3
<b>Group: /atlas_impulse_response</b>				
Description	(Attribute)	Contains parameters to characterize the ATLAS pulse energy and pulse shape, derived from the Start Pulse Detector data. These parameters are at the ICESat-2 geolocation segment rate (~20m along-track)		
<b>Group: /atlas_impulse_response/pce_x_spotx</b>				
Description	(Attribute)	Contains parameters to characterize the ATLAS impulse response from the TEP photon histograms available for two of the three strong beams.		
<b>Group: /atlas_impulse_response/pce_x_spotx/tep_histogram</b>				
Description	(Attribute)	Subgroup that contains the time of the histogram centers and the normalized histogram counts for each bin.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
reference_tep_flag (Compact Dataset)	INTEGER_4 (1)	Reference TEP Used (not_set)	1 ATL03 ATBD, Section 7.2	Flag that indicates the reference TEP has been used in place of a more recent TEP realization. 0=dynamic TEP used; 1=static reference TEP used. flag_values: 0, 1 flag_meanings : dynamic_tep_used, reference_tep_used
tep_bckgrd (Chunked Dataset)	INTEGER_4 (:)	TEP Background (not_set)	counts ATL02 ATBD, Section 7.2	The average number of counts in the TEP histogram bins, after excluding bins that likely contain the transmit pulse.
tep_duration (Chunked Dataset)	DOUBLE (:)	TEP Duration (not_set)	seconds ATL02 ATBD, Section 7.2	The duration (or width) of data in the TEP histogram. Will generally be greater than 10 seconds.
tep_hist (Chunked Dataset)	DOUBLE (:)	TEP Histogram (not_set)	counts ATL02 ATBD, Section 7.2	The normalized number of counts in each bin of the TEP histogram.
tep_hist_sum (Chunked Dataset)	INTEGER_8 (:)	TEP Histogram Sum (not_set)	counts ATL02 ATBD, Section 7.2	The total number of counts in the TEP histogram, after removing the background.
tep_hist_time (Chunked Dataset)	DOUBLE (:)	TEP Histogram Time (not_set)	seconds ATL02 ATBD, Section 7.2	The times associated with the TEP histogram bin centers, measured from the laser transmit time.
tep_tod (Chunked Dataset)	DOUBLE (:)	TEP Time Of Day (time)	seconds since 2018-01-01 ATL02 ATBD, Section 7.2	The time of day at of the start of the data within the TEP histogram, in seconds since the ATLAS SDP GPS Epoch. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
<b>Group: /gtx</b>				
Description	(Attribute)	Each group contains the segments for one Ground Track. As ICESat-2 orbits the earth, sequential transmit pulses illuminate six ground tracks on the surface of the earth. The track width is approximately 14m. Each ground track is numbered, according to the laser spot number that generates a given ground track. Ground tracks are numbered from the left to the right in the direction of spacecraft travel as: 1L, 1R in the left-most pair of beams; 2L, 2R for the center pair of beams; and 3L, 3R for the right-most pair of beams.		
<b>Group: /gtx/bckgrd_atlas</b>				
Description	(Attribute)	Contains data related to the 50-shot background count, including telemetry and range windows.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
bckgrd_counts (Chunked Dataset)	INTEGER_4 (:)	ATLAS 50-shot background count (not_set)	counts ATL03 ATBD Section 7.3	Onboard 50 shot background (200 Hz) sum of photon events within the altimetric range window.
bckgrd_counts_reduced (Chunked Dataset)	INTEGER_4 (:)	ATLAS 50-shot background count - reduced (not_set)	counts ATL03 ATBD Section 7.3	Number of photon counts in the 50-shot sum after subtracting the number of signal photon events, defined as in ATBD Section 5, in that span.
bckgrd_hist_top (Chunked Dataset)	FLOAT (:)	Top of the altimetric range window (not_set)	meters ATL03 ATBD Section 7.3	The height of the top of the altimetric histogram, in meters above the WGS-84 ellipsoid, with all geophysical corrections applied. Parameter is ingested at 50-Hz, and values are repeated to form a 200-Hz array.
bckgrd_int_height (Chunked Dataset)	FLOAT (:)	Altimetric range window width (not_set)	meters ATL03 ATBD Section 7.3	The height of the altimetric range window. This is the height over which the 50-shot sum is generated. Parameter is ingested at 50-Hz, and values are repeated to form a 200-Hz array.
bckgrd_int_height_reduced	FLOAT	Altimetric range window height - reduced	meters	The height of the altimetric range window after subtracting

(Chunked Dataset)	(:)	(not_set)	ATL03 ATBD Section 7.3	the height span of the signal photon events in the 50-shot span.
bckgrd_rate (Chunked Dataset)	FLOAT (:)	Background count rate based on the ATLAS 50-shot sum (not_set)	counts / second ATL03 ATBD Section 7.3	The background count rate from the 50-shot altimetric histogram after removing the number of likely signal photons based on Section 5.
delta_time (Chunked Dataset)	DOUBLE (:)	Time at the start of ATLAS 50-shot sum (time)	seconds since 2018-01-01 ATL02	Elapsed GPS Seconds from the ATLAS SDP GPS Epoch, referenced to the start of the 50-shot sum. This is based on every fiftieth laser fire time, which leads to a very close alignment with major frame boundaries (+/- 1 shot). The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
pce_mframe_cnt (Chunked Dataset)	INTEGER_8 (:)	PCE Major frame counter (not_set)	counts ATL02	Major Frame ID - The major frame ID is read from the DFC and starts counting at DFC POR. The counter is used to identify individual major frames across diag and science packets. This counter can go for about 2.7 years before rolling over. It is in the first time tag science packet. Used as part of the photon ID and the safest way to align data within different APIDs or at different rates.
t1m_height_band1 (Chunked Dataset)	FLOAT (:)	Height of the telemetry band 1 (not_set)	meters ATL03 ATBD, Section 7.3.2	The height in meters of the telemetry band 1.
t1m_height_band2 (Chunked Dataset)	FLOAT (:)	Height of the telemetry band 2 (not_set)	meters ATL03 ATBD, Section 7.3.2	The height in meters of the telemetry band 2. (if 0, second band is not present).
t1m_top_band1 (Chunked Dataset)	FLOAT (:)	Ellipsoidal height of the top of the telemetry band 1. (not_set)	meters ATL03 ATBD, Section 3.2, 7.3.2	The ellipsoidal heights with respect to WGS-84 of the top of the telemetry band 1, with all geophysical corrections applied.
t1m_top_band2 (Chunked Dataset)	FLOAT (:)	Ellipsoidal height of the top of the telemetry band 2. (not_set)	meters ATL03 ATBD, Section 3.2, 7.3.2	The ellipsoidal heights with respect to WGS-84 of the top of the telemetry band 2, with all geophysical corrections applied.
<b>Group: /gtx/geolocation</b>				
Description	(Attribute)	Contains parameters related to geolocation. The rate of all of these parameters is at the rate corresponding to the ICESat-2 Geolocation Along Track Segment interval (nominally 20 m along-track). In the case of no photons within the segment (segment_ph_cnt=0), most parameters are filled with invalid or best-estimate values. Maintaining geolocation segments with no photons allows for the geolocation segment arrays to be directly aligned across the gtx groups.		
data_rate	(Attribute)	Data within this group are stored at the ICESat-2 20m segment rate.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
altitude_sc (Chunked Dataset)	DOUBLE (:)	Altitude (not_set)	meters ATL03g ATBD, Section 3.4	Height of the spacecraft above the WGS84 ellipsoid.
bounce_time_offset (Chunked Dataset)	FLOAT (:)	ground bounce time offset (not_set)	seconds ATL03 ATBD, Section 3.3	The difference between the transmit time and the ground bounce time of the reference photons.
delta_time (Chunked Dataset)	DOUBLE (:)	Delta Time (time)	seconds since 2018-01-01 Derived	Transmit time of the reference photon, measured in seconds from the atlas_sdp_gps_epoch. If there is no reference photon, this time corresponds to the approximate mid-point time associated with the along-track geolocation segment edge. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
neutat_delay_derivative (Chunked Dataset)	FLOAT (:)	(Neutral Atmosphere delay)/dh (not_set)	meters/meters ATL03a ATBD	Change in neutral atmospheric delay per height change
neutat_delay_total (Chunked Dataset)	FLOAT (:)	Total Neutral Atmospheric Delay (not_set)	meters ATL03a ATBD	Total neutral atmosphere delay correction (wet+dry).
neutat_ht (Chunked Dataset)	FLOAT (:)	Neutral atmosphere ref height (not_set)	meters ATL03a ATBD	Reference height of the neutral atmosphere range correction
ph_index_beg (Chunked Dataset)	INTEGER_8 (:)	Photon Index Begin (not_set)	counts Derived	Index (1-based) within the photon-rate data of the first photon within this segment. Use in conjunction with segment_ph_cnt.
podppd_flag (Chunked Dataset)	INTEGER_1 (:)	POD_PPD Flag (not_set)	1 ANC04, ANC05	Composite POD/PPD flag that indicates the quality of input geolocation products for the specific ATL03 segment. A non-zero value may indicate that geolocation solutions are degraded. The ATL03 sigma values should indicate the

				degree of uncertainty associated with the degradation. Possible values are: 0=NOMINAL; 1=LRS; 2=LASERS; 3=GYRO; 4=SST1; 5=SST2; 6=ATT_INTERP; 7=MANEUVER; 8=GPS_DATA_GAP; 9-ST_BLINDING; 10=OTHER. Values 1-6 (PPD) are prioritized over values 7-10 (POD). In the case where both POD and PPD report an error, only the PAD value is indicated. flag_values: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 flag_meanings : nominal lrs lasers gyro sst1 sst2 att_interp maneuver gps_data_gap st_blinding other
range_bias_corr (Chunked Dataset)	FLOAT (:)	range bias correction (not_set)	meters ATL03G ATBD, Section 3.6	The range_bias estimated from geolocation analysis.
ref_azimuth (Chunked Dataset)	FLOAT (:)	Azimuth (azimuth)	radians ATL03G ATBD, Section 3.3	Azimuth of the unit pointing vector for the reference photon in the local ENU frame in radians. The angle is measured from North and positive towards East.
ref_elev (Chunked Dataset)	FLOAT (:)	elevation (elevation)	radians ATL03G ATBD, Section 3.3	Elevation of the unit pointing vector for the reference photon in the local ENU frame in radians. The angle is measured from East-North plane and positive towards Up
reference_photon_index (Chunked Dataset)	INTEGER_4 (:)	Reference Photon Index (not_set)	counts ATL03 ATBD, Section 3.2	Index of the reference photon within the set of photons grouped within in segment. To recover the position of the reference photon within the photon-rate arrays, add ref_ph_ndx to the corresponding ph_ndx_beg and subtract 1. If no reference photon was selected, this value will indicate that the reference photon defaulted to the first photon. In the case of no photons within the segment (segment_ph_cnt=0), the value should be 0.
reference_photon_lat (Chunked Dataset)	DOUBLE (:)	Segment Latitude (latitude)	degrees_north ATL03G ATBD, Section 3.4	Latitude of each reference photon. Computed from the ECF Cartesian coordinates of the bounce point. In the case of no photons within the segment (segment_ph_cnt=0), the coordinates are the midpoint of the geolocation segment on the reference ground track.
reference_photon_lon (Chunked Dataset)	DOUBLE (:)	Segment Longitude (longitude)	degrees_east ATL03G ATBD, Section 3.4	Longitude of each reference photon. Computed from the ECF Cartesian coordinates of the bounce point. In the case of no photons within the segment (segment_ph_cnt=0), the coordinates are the midpoint of the geolocation segment on the reference ground track.
segment_dist_x (Chunked Dataset)	DOUBLE (:)	Segment Distance from EQC (not_set)	meters Derived	Along-track distance from the equator crossing to the start of the 20 meter geolocation segment.
segment_id (Chunked Dataset)	INTEGER_4 (:)	along-track segment ID number. (not_set)	1 ATL03 ATBD, Section 3.1	A 7 digit number identifying the along-track geolocation segment number. These are sequential, starting with 1 for the first segment after an ascending equatorial crossing node.
segment_length (Chunked Dataset)	DOUBLE (:)	along-track segment length (not_set)	meters ATL03 ATBD, Section 3.1	The along-track length of the along-track segment. Nominally these are 20m, but they vary from 19.8m to 20.2m.
segment_ph_cnt (Chunked Dataset)	INTEGER_4 (:)	Number of photons (not_set)	counts Derived	Number of photons in a given along-track segment. In the case of no photons within the segment (segment_ph_cnt=0), most other parameters are filled with invalid or best-estimate values. Maintaining geolocation segments with no photons allows for the geolocation segment arrays to be directly aligned across the gtx groups.
sigma_across (Chunked Dataset)	FLOAT (:)	across-track geolocation uncertainty (not_set)	meters ATL03G ATBD	Estimated Cartesian across-track uncertainty (1-sigma) for the reference photon
sigma_along (Chunked Dataset)	FLOAT (:)	along-track geolocation uncertainty (not_set)	meters ATL03G ATBD	Estimated cartesian along-track uncertainty (1-sigma) for the reference photon
sigma_h (Chunked Dataset)	FLOAT (:)	height uncertainty (not_set)	1 ATL03G ATBD, Section 3.6	Estimated height uncertainty (1-sigma) for the reference photon bounce point.
sigma_lat (Chunked Dataset)	FLOAT (:)	latitude uncertainty (not_set)	1 ATL03G ATBD, Section 3.6	Estimated geodetic Latitude uncertainty (1-sigma), for the reference photon bounce point.
sigma_lon (Chunked Dataset)	FLOAT (:)	longitude uncertainty (not_set)	degrees ATL03G ATBD, Section 3.6	Estimated geodetic east Longitude uncertainty (1-sigma), for the reference photon bounce point.
solar_azimuth (Chunked Dataset)	FLOAT (:)	solar azimuth (not_set)	degrees_east ATL03G ATBD, Section 3.3	The azimuth of the sun position vector from the reference photon bounce point position in the local ENU frame. The angle is measured from North and is positive towards East. ATL03g provides this value in radians; it is converted to degrees for ATL03 output.
solar_elevation (Chunked Dataset)	FLOAT (:)	solar elevation (not_set)	degrees ATL03G ATBD, Section 3.3	The elevation of the sun position vector from the reference photon bounce point position in the local ENU frame. The angle is measured from the East-North plane and is positive Up. ATL03g provides this value in radians; it is converted to

				degrees for ATL03 output.
surf_type (Chunked Dataset)	INTEGER_1 (5, :)	Surface Type (not_set)	1 ATL03 ATBD, Section 4	Flags describing which surface types this interval is associated with. 0=not type, 1=is type. Order of array is land, ocean, sea ice, land ice, inland water. flag_values: 0, 1 flag_meanings : not_type is_type
tx_pulse_energy (Chunked Dataset)	FLOAT (:)	Transmit Pulse Energy (not_set)	Joules ATL02 ATBD, Section 7.2	The average transmit pulse energy, measured by the internal laser energy monitor, split into per-beam measurements.
tx_pulse_skew_est (Chunked Dataset)	FLOAT (:)	Transmit Pulse Skew Estimate (not_set)	seconds ATL02 ATBD, Section 7.2	The difference between the averages of the lower and upper threshold crossing times. This is an estimate of the transmit pulse skew.
tx_pulse_width_lower (Chunked Dataset)	FLOAT (:)	Transmit Pulse Energy Lower Width (not_set)	seconds ATL02 ATBD, Section 7.2	The average distance between the lower threshold crossing times measured by the Start Pulse Detector.
tx_pulse_width_upper (Chunked Dataset)	FLOAT (:)	Transmit Pulse Energy Upper Width (not_set)	seconds ATL02 ATBD, Section 7.2	The average distance between the upper threshold crossing times measured by the Start Pulse Detector.
velocity_sc (Chunked Dataset)	FLOAT (3, :)	spacecraft velocity (not_set)	meters/second ATL03G ATBD	Spacecraft velocity components (east component, north component, up component) an observer on the ground would measure. While values are common to all beams, this parameter is naturally produced as part of geolocation.

**Group: /gtx/geophys\_corr**

Description	(Attribute)	Contains parameters used to correct photon heights for selected geophysical effects. Additional geophysical parameters (dac and tide_ocean) are not applied and provided for informational purposes only. All parameters are posted at the same interval as the ICESat-2 Geolocation Along-Track Segment interval (nominally 20m along-track). In the case of no photons within the segment (./geolocation/segment_ph_cnt=0), most parameters are filled with invalid or best-estimate values. Maintaining geolocation segments with no photons allows for the geolocation segment arrays to be directly aligned across the gtx groups.		
data_rate	(Attribute)	These parameters are stored at the ICESat-2 Geolocation Along Track Segment rate (nominally every 20 m along-track).		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
dac (Chunked Dataset)	FLOAT (:)	Dynamic Atmosphere Correction (not_set)	meters ATL03 ATBD, Section 6.3.2	Dynamic Atmospheric Correction (DAC) includes inverted barometer (IB) effect. This correction is not applied to the photon heights and provided only as supplemental information.
delta_time (Chunked Dataset)	DOUBLE (:)	Elapsed GPS seconds (time)	seconds since 2018-01-01 Operations	Elapsed seconds from the ATLAS SDP GPS Epoch, corresponding to the transmit time of the reference photon. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
dem_flag (Chunked Dataset)	INTEGER_1 (:)	dem source flag (not_set)	1 ATL03 ATBD Section 6.3	Indicates source of the DEM height. Values: 0=None, 1=Arctic, 2=GMTED, 3=MSS, 4=Antarctic. flag_values: 0, 1, 2, 3, 4 flag_meanings : none arctic gmted mss antarctic
dem_h (Chunked Dataset)	FLOAT (:)	DEM Height (not_set)	meters ATL03 ATBD Section 6.3	Best available DEM (in priority of Arctic/Antarctic/GMTED/MSS) value at the location of the reference photon.
geoid (Chunked Dataset)	FLOAT (:)	Geoid (not_set)	meters ATL03 ATBD, Section 6.3.8	Geoid height above WGS-84 reference ellipsoid (range -107 to 86m). Not applied on the product; requested by higher-level products.
tide_earth (Chunked Dataset)	FLOAT (:)	Earth Tide (not_set)	meters ATL03 ATBD, Section 6.3.3	Solid Earth Tides
tide_equilibrium (Chunked Dataset)	FLOAT (:)	Long Period Equilibrium Tide (not_set)	meters ATL03 ATBD, Section 6.3.1	Long period equilibrium tide self-consistent with ocean tide model (+/-0.04m). This correction is not applied to the photon heights and is provided only as a supplemental information.
tide_load (Chunked Dataset)	FLOAT (:)	Load Tide (not_set)	meters ATL03 ATBD, Section 6.3.4	Load Tide - Local displacement due to Ocean Loading (-6 to 0 cm).
tide_oc_pole (Chunked Dataset)	FLOAT (:)	Ocean Pole Tide (not_set)	meters ATL03 ATBD, Section 6.3.6	Surface deformation of the Earth due to loading from the centrifugal effect of polar motion upon the oceans (-2 to 2 mm).
tide_ocean (Chunked Dataset)	FLOAT (:)	Ocean Tide (not_set)	meters ATL03 ATBD, Section 6.3.1	Ocean Tides including diurnal and semi-diurnal (harmonic analysis), and longer period tides (dynamic and self-consistent equilibrium). This correction is not applied to the photon heights and provided only as supplemental information.

tide_pole (Chunked Dataset)	FLOAT (:)	Solid Earth Pole Tide (not_set)	meters ATL03 ATBD, Section 6.3.5	Solid Earth Pole Tide -Rotational deformation due to polar motion (-1.5 to 1.5 cm).
<b>Group: /gtx/heights</b>				
Description	(Attribute)	Contains arrays of the parameters for each received photon.		
data_rate	(Attribute)	Data are stored at the photon detection rate.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
delta_time (Chunked Dataset)	DOUBLE (:)	Elapsed GPS seconds (time)	seconds since 2018-01- 01 Operations	The transmit time of a given photon, measured in seconds from the ATLAS Standard Data Product Epoch. Note that multiple received photons associated with a single transmit pulse will have the same delta_time. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01- 06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
dist_ph_across (Chunked Dataset)	FLOAT (:)	Distance off RGT. (not_set)	meters ATL03 ATBD, Section 3.1	Across-track distance projected to the ellipsoid of the received photon from the reference ground track. This is based on the Along-Track Segment algorithm described in Section 3.1.
dist_ph_along (Chunked Dataset)	FLOAT (:)	Distance from equator crossing. (not_set)	meters ATL03 ATBD, Section 3.1	Along-track distance in a segment projected to the ellipsoid of the received photon, based on the Along-Track Segment algorithm. Total along track distance can be found by adding this value to the sum of segment lengths measured from the start of the most recent reference groundtrack.
h_ph (Chunked Dataset)	FLOAT (:)	Photon WGS84 Height (height)	meters ATL03g ATBD, Section 3.4	Height of each received photon, relative to the WGS-84 ellipsoid including the geophysical corrections noted in Section 6. Please note that neither the geoid, ocean tide nor the dynamic atmosphere (DAC) corrections are applied to the ellipsoidal heights.
lat_ph (Chunked Dataset)	DOUBLE (:)	Latitude (latitude)	degrees_north ATL03g ATBD, Section 3.4	Latitude of each received photon. Computed from the ECF Cartesian coordinates of the bounce point.
lon_ph (Chunked Dataset)	DOUBLE (:)	Longitude (longitude)	degrees_east ATL03g ATBD, Section 3.4	Longitude of each received photon. Computed from the ECF Cartesian coordinates of the bounce point.
pce_mframe_cnt (Chunked Dataset)	UINT_4_LE (:)	PCE Major frame counter (not_set)	counts Retained from prior a_alt_science_ph packet	The major frame counter is read from the digital flow controller in a given PCE card. The counter identifies individual major frames across diag and science packets. Used as part of the photon ID.
ph_id_channel (Chunked Dataset)	UINT_1_LE (:)	Receive channel id (not_set)	1 Derived as part of Photon ID	Channel number assigned for each received photon event. This is part of the photon ID. Values range from 1 to 120 to span all channels and rise/fall edges. Values 1 to 60 are for falling edge; PCE1 (1 to 20), PCE 2 (21 to 40) and PCE3 (41 to 60). Values 61 to 120 are for rising edge; PCE1 (61 to 80), PCE 2 (81 to 100) and PC3 (101 to 120).
ph_id_count (Chunked Dataset)	INTEGER_1 (:)	photon event counter (not_set)	counts Derived as part of Photon ID	The photon event counter is part of photon ID and counts from 1 for each channel until reset by laser pulse counter.
ph_id_pulse (Chunked Dataset)	UINT_1_LE (:)	laser pulse counter (not_set)	counts Derived as part of Photon ID	The laser pulse counter is part of photon ID and counts from 1 to 200 and is reset for each new major frame.
signal_conf_ph (Chunked Dataset)	INTEGER_1 (5, :)	Photon Signal Confidence (not_set)	1 ATL03 ATBD, Section 5, Conf	Confidence level associated with each photon event selected as signal. 0=noise. 1=added to allow for buffer but algorithm classifies as background; 2=low; 3=med; 4=high). This parameter is a 5xN array where N is the number of photons in the granule, and the 5 rows indicate signal finding for each surface type (in order: land, ocean, sea ice, land ice and inland water). Events not associated with a specific surface type have a confidence level of -1. Events evaluated as TEP returns have a confidence level of -2. flag_values: -2, -1, 0, 1, 2, 3, 4 flag_meanings : possible_tep not_considered noise buffer low medium high
<b>Group: /gtx/signal_find_output</b>				
Description	(Attribute)	Parameters output for each time interval for which signal photons were selected, and the confidence flag set, based on the algorithm in Section 5. Histogram parameters are from the histogram that was used to identify signal photons and set the confidence parameter for a given time increment.		
data_rate	(Attribute)	Data are stored at the rate of signal finding time intervals.		

Group: /gtx/signal_find_output/surf_type				
Description	(Attribute)	Surface-type specific parameters output for each time interval for which signal photons were selected, based on the algorithm in Section 5. Histogram parameters are from the histogram that was used to identify signal photons and set the confidence parameter for a given time increment.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
bckgrd_mean (Chunked Dataset)	FLOAT (:)	background counts per bin (not_set)	counts ATL03 ATBD, Section 5	The mean of the number of background counts expected in one height bin of the histogram of width dzATM over time period, dtATM
bckgrd_sigma (Chunked Dataset)	FLOAT (:)	background counts per bin sigma (not_set)	counts ATL03 ATBD, Section 5	The standard deviation of the number of background counts expected in one height bin of the histogram of width dzATM over time period, dtATM
delta_time (Chunked Dataset)	DOUBLE (:)	Elapsed GPS seconds (time)	seconds since 2018-01-01 Derived via Time Tagging	Number of GPS seconds since the ATLAS SDP epoch. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
t_pc_delta (Chunked Dataset)	FLOAT (:)	bin width size (not_set)	seconds ATL03 ATBD, Section 5	The histogram bin width (integration time) along-track used to find signal photons.
z_pc_delta (Chunked Dataset)	FLOAT (:)	bin height size (not_set)	meters ATL03 ATBD, Section 5	Height bin size of the histogram used to find signal photons.
Group: /orbit_info				
Description	(Attribute)	Contains data that are common among all beams for the granule. These parameters are constants for a given granule.		
data_rate	(Attribute)	These parameters are constant for a given granule.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
crossing_time (Chunked Dataset)	DOUBLE (:)	Ascending Node Crossing Time (time)	seconds since 2018-01-01 POD/PPD	The time, in seconds since the ATLAS SDP GPS Epoch, at which the ascending node crosses the equator. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
cycle_number (Chunked Dataset)	INTEGER_1 (:)	Cycle Number (not_set)	counts POD/PPD	Tracks the number of 91-day cycles in the mission, beginning with 01. A unique orbit number can be determined by subtracting 1 from the cycle_number, multiplying by 1387 and adding the rgt value.
lan (Chunked Dataset)	DOUBLE (:)	Ascending Node Longitude (not_set)	degrees_east POD/PPD	Longitude at the ascending node crossing.
orbit_number (Chunked Dataset)	UINT_2_LE (:)	Orbit Number (not_set)	1 Operations	Unique identifying number for each planned ICESat-2 orbit.
rgt (Chunked Dataset)	INTEGER_2 (:)	Reference Ground track (not_set)	counts POD/PPD	The reference ground track (RGT) is the track on the earth at which a specified unit vector within the observatory is pointed. Under nominal operating conditions, there will be no data collected along the RGT, as the RGT is spanned by GT2L and GT2R. During slews or off-pointing, it is possible that ground tracks may intersect the RGT. The ICESat-2 mission has 1387 RGTs.
sc_orient (Chunked Dataset)	INTEGER_1 (:)	Spacecraft Orientation (not_set)	1 POD/PPD	This parameter tracks the spacecraft orientation between forward, backward and transitional flight modes. ICESat-2 is considered to be flying forward when the weak beams are leading the strong beams; and backward when the strong beams are leading the weak beams. ICESat-2 is considered to be in transition while it is maneuvering between the two orientations. Science quality is potentially degraded while in transition mode. flag_values: 0, 1, 2 flag_meanings : backward forward transition
sc_orient_time (Chunked Dataset)	DOUBLE (:)	Time of Last Spacecraft Orientation Change (time)	seconds since 2018-01-01 POD/PPD	The time of the last spacecraft orientation change between forward, backward and transitional flight modes, expressed in seconds since the ATLAS SDP GPS Epoch. ICESat-2 is considered to be flying forward when the weak beams are leading the strong beams; and backward when the strong beams are leading the weak beams. ICESat-2 is considered to be in transition while it is maneuvering between the two orientations. Science quality is potentially degraded while in transition mode. The ATLAS Standard Data Products (SDP) epoch offset is defined within

				/ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
--	--	--	--	--

**Group: /quality\_assessment**

Description	(Attribute)	Contains quality assessment data. This may include QA counters, QA along-track data and/or QA summary data.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
delta_time (Contiguous Dataset)	DOUBLE (1)	Elapsed GPS seconds (time)	seconds since 2018-01-01 Operations	Number of GPS seconds since the ATLAS SDP epoch. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
qa_granule_fail_reason (Compact Dataset)	INTEGER_4 (1)	Granule Failure Reason (not_set)	1 Operations	Flag indicating granule failure reason. 0=no failure; 1=processing error; 2=Insufficient output data was generated; 3=TBD Failure; 4=TBD_Failure; 5=other failure. flag_values: 0, 1, 2, 3, 4, 5 flag_meanings : no_failure PROCESS_ERROR INSUFFICIENT_OUTPUT failure_3 failure_4 OTHER_FAILURE
qa_granule_pass_fail (Compact Dataset)	INTEGER_4 (1)	Granule Pass Flag (not_set)	1 Operations	Flag indicating granule quality. 0=granule passes automatic QA. 1=granule fails automatic QA. flag_values: 0, 1 flag_meanings : PASS FAIL

**Group: /quality\_assessment/gtx**

Description	(Attribute)	Each group contains the quality assessment information for one Ground Track.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
qa_perc_signal_conf_ph_high (Contiguous Dataset)	DOUBLE (5,1)	Percent_Signal_Conf_Ph_High (not_set)	percent ATL03 ATBD, Section 8	The percentage of high-confidence signal photons for each surface type, based on the total number of photons for each surface type.
qa_perc_signal_conf_ph_low (Contiguous Dataset)	DOUBLE (5,1)	Percent_Signal_Conf_Ph_Low (not_set)	percent ATL03 ATBD, Section 8	The percentage of low-confidence signal photons for each surface type, based on the total number of photons for each surface type.
qa_perc_signal_conf_ph_med (Contiguous Dataset)	DOUBLE (5,1)	Percent_Signal_Conf_Ph_Med (not_set)	percent ATL03 ATBD, Section 8	The percentage of medium-confidence signal photons for each surface type, based on the total number of photons for each surface type.
qa_perc_surf_type (Contiguous Dataset)	DOUBLE (5,1)	Percent_Surface_Type (not_set)	percent ATL03 ATBD, Section 8	The percentage of geolocation segments for each surface type, based on the total number of geolocation segments.
qa_total_signal_conf_ph_high (Contiguous Dataset)	INTEGER_8 (5,1)	Total_Signal_Conf_Ph_High (not_set)	1 ATL03 ATBD, Section 8	The total number of high-confidence signal photons for each surface type.
qa_total_signal_conf_ph_low (Contiguous Dataset)	INTEGER_8 (5,1)	Total_Signal_Conf_Ph_Low (not_set)	1 ATL03 ATBD, Section 8	The total number of low-confidence signal photons for each surface type.
qa_total_signal_conf_ph_med (Contiguous Dataset)	INTEGER_8 (5,1)	Total_Signal_Conf_Ph_Med (not_set)	1 ATL03 ATBD, Section 8	The total number of medium-confidence signal photons for each surface type.